(In)efficient repo markets

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Repo markets: Efficiency vs. resilience

Fact 1  Repo is important short-term funding market (daily outstanding repo >$2T)
Fact 2  Repo runs are recurrent phenomenon (Duffie (2020), He et al. (2021))
Fact 3  Repo market structures differ in efficiency & resilience (Mancini et al. 2016)
Fact 4  Repo markets reliant on liquid collateral in crisis times (Infante & Saravay 2020)

\[\text{Average Daily Outstanding - Repo ($T)}\]

- Overnight
- Term

(a) Repo market size (SIFMA 2021)
(b) Repo blowup (FT 2019)
Our paper

- Research questions
  - What are the trade offs between different repo market structures?
  - What is the optimal repo market design?
  - What is the role of collateral across different markets?

- Existing repo market structures trade off
  - Efficient resource allocation
  - Resilience to runs

- Both trading & clearing mechanisms impact tradeoff

- Non-anonymous trading + central clearing w/ **two-tiered guarantee fund**
  - Liquidity fund (or collateral upgrade) $\rightarrow$ Illiquidity mutualization
  - Default fund $\rightarrow$ Default loss mutualization
Repo trading & clearing mechanisms affect welfare

- Existing repo markets combine different trading & clearing mechanisms

<table>
<thead>
<tr>
<th>Trading</th>
<th>Clearing</th>
<th>direct</th>
<th>central</th>
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<tbody>
<tr>
<td>non-anonymous</td>
<td>OTC repo market (bilateral &amp; tri-party U.S. customer repo)</td>
<td>Clearinghouse (reform proposals, e.g., Duffie (2020))</td>
<td></td>
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<tr>
<td>anonymous</td>
<td>COB without novation (MTFs with ex-post name give-up)</td>
<td>CCP = COB + novation + default fund (GCF Repo &amp; FICC DVP via e.g. BrokerTec, EUREX, LCH.Clearnet)</td>
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- COB = Anonymous non-discriminatory repo pricing
- Novation = CCP becomes legal counterparty
- Default fund = Insurance against borrower default
Collateral buffer: Anonymity provides insurance to $L$-type since collateral buffers shock

Inefficient liquidation: Anonymity forces inefficient liquidation of $H$-type assets

Narrow run: Run on $L$-type borrowers

Systemic run: Run on $L$- & $H$-type borrowers (market failure)
Novation excludes low-quality borrowers → Systemic run can be averted

Default fund provides insurance → Repo market absorbs larger funding shocks
#3 Improving repo market design

1. **Central clearing** of bilateral & tri-party trades (Duffie, 2020)
   - Improves run resilience, but not resource allocation

2. **Hybrid trading** in centrally-cleared markets
   - Switch from anonymous to non-anonymous trading when funding becomes tight
   - Improves resource allocation

3. **Two-tiered guarantee fund** is privately optimal market solution

<table>
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<th><strong>Liquidity fund</strong></th>
<th><strong>Default fund</strong></th>
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<tr>
<td>Collateral transfers support illiquid yet solvent borrowers</td>
<td>Profit transfers repay lenders of defaulting borrower</td>
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<td>Collateral liquidated before LTT</td>
<td>→ Increases run resilience</td>
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<tr>
<td>→ Improves resource allocation</td>
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7 / 23
Model

- 3-period model of incentive-based runs at rollover stage

- 2 borrowers have ex-ante identical, ex-post heterogeneous long-term technologies (LTT) for which they need financing

- Maturity mismatch: LTT is financed with short-term loans

- Demand-side asymmetric info & supply-side funding scarcity
  - Borrowers learn over time their technology’s quality $R^\omega \geq 1$, $\omega \in \{L, H\}$, where $Pr(R^H) = \beta$
  - 2m lenders are subject to funding shock $f \geq 0$ with prob $\alpha$

- Risk-free asset can be used as collateral $\kappa_t k_0$

- Pecking order: Liquidation of collateral is cheaper than LTT
  - Illiquid LTT has firesale value $\lambda \in (0, 1) < \text{collateral quality } \kappa_1$
Borrowers and first-round lenders negotiate \((c_1, \ell_0)\).

Borrowers invest \(i_0\) in illiquid LTT.

Borrowers repay loans with new loan \((c_2, \ell_1)\), collateral \(\kappa_1 w_1\) and LTT \(\lambda z_1\).

Second-round lenders are subject to funding shock \(f\).

Borrowers observe LTT \(\omega \in \{L, H\}\).

Payoffs \(R^\omega\) from LTT & \(\kappa_2\) from collateral realize.
The rollover decision

Repayment condition:

\[- \ell_0 c_1 + \ell_1 + \kappa_1 w_1 + \lambda z_1 = 0\]

Borrower:

\[R^\omega(i_0 - z_1) - c_2 \ell_1 + \kappa_2(k_0 - w_1) \geq 0\]

Second-round lenders:

\[c_2 \geq 1\]

Ex-post net welfare = borrowers’ profit + lenders’ profit
First best solution

- Pecking order due to illiquidity discounts
- All collateral liquidated at $\kappa_1$
- Welfare decreases in funding shock $f$ depending on liquidation of collateral vs LTT
Constrained FB: Non-anonymous OTC

- Inefficient liquidation of $L$-type LTT beyond collateral $\frac{\kappa_1}{2}$
- **Narrow run** on $L$-type for $f \geq f^{OTC} = \frac{R^L - 1}{R^L - \lambda} \frac{\lambda}{2} + \frac{R^L}{R^L - \lambda} \frac{\kappa_1}{2}$
- Decentralized non-anonymous trading puts burden of funding shock on low-quality borrowers
Pooling equilibrium: Anonymous COB

- One-fits-all loan in anonymous market has bright & dark side
  - Anonymity provides insurance for $f \leq \kappa_1$, but reduce total revenue due to inefficient liquidation of $H$'s LTT for $f > S$
  - Leads to systemic run for large funding shocks $f \geq f^{\text{CCP}}$
  - $S = \left( \frac{R^H}{\lambda} - \frac{\kappa_2}{\kappa_1} \right) \frac{\kappa_1 \lambda}{R^H - R^L}$ increases in illiquidity $1/\lambda$ & quality $\kappa_1$
CCP = COB + novation + default fund

- **Novation** prevents systemic runs
- **Default fund** increases resilience to narrow runs
- **OTC market** dominates CCP over range $f \in (S, f^{OTC})$
Two-tiered guarantee fund

- Participants transfer both safe collateral & risky assets into escrow accounts.
- Collateral transfer resembles collateral upgrade by ECB & Fed (Carlson & Macchiavelli, 2018).
Conclusion

- Repo markets trade off efficient allocation of liquidity with resilience to runs
- Trading & clearing mechanisms impact allocation-resilience tradeoff
  - Common mechanisms are inefficient & welfare rankings depend on funding tightness
  - Clearing OTC markets centrally & hybrid trading in CCP markets improve welfare
  - Welfare is maximized with a two-tiered guarantee fund
- Liquid collateral improves allocation & resilience to runs
- Model helps to reconcile the convenience yield puzzle (He et al. 2021)
Novation excludes insolvent borrowers

- Prevents systemic runs
- No effect on resource allocation nor on run threshold
Repo market reform #1: Hybrid trading in a CCP

- Alternative reform is to modernize trading mechanism
- Switch from anonymous to non-anonymous trading at $S$
  - Similar to upstairs market for equities
- Improves resource allocation for $f > S$
Repo market reform #2: Centrally cleared OTC

- Central clearing of repos improves run resilience
- But, central clearing leaves resource allocation unaffected!
Collateral quality and run resiliency

- CCP market’s resilience to run is more sensitive to collateral quality than OTC market’s resilience when LTT is illiquid

- Recall, $f^{OTC} < f^{CCP}$: Might expect that marginal increase in collateral value would benefit borrowers in OTC market most

- Not true when LTT is illiquid! In CCP markets, high-quality borrower is forced to partially liquidate LTT, which is the most valuable asset in the economy, and hence its liquidation is particularly costly
Collateral convenience yield

- Why is an asset used as collateral instead of being sold on the spot market (Parlatore, 2019; Madison, 2020)?

In OTC markets, when a run becomes likely, ex-ante convenience yield increases (decreases) in the funding shock if expected borrower quality is low (high).

- GFC: Expected borrower quality was low due to large positions in ABS on banks’ balance sheets.

- Covid-19: Banks were better capitalized & had higher creditworthiness than during GFC.

- Support for empirical evidence showing that convenience yield increased during GFC & decreased in Covid-19 (He et al. 21)
Collateral scarcity and negative NPV

“Market participants have voiced concerns that in anonymous CCP markets low-quality borrowers can hide amongst high-quality borrowers.” (Financial Times, July 7, 2013 & January 8, 2018)

Collateral has a skin in the game effect which prevents risk hoarding in anonymous COB markets.
Literature


▶ Interbank market: Heider et al. (2015), Martin et al. (2014a, b) and Brunnermeier and Pedersen (2009) – no CCP

▶ CCP: Kuong and Maurin (2021) – moral hazard & monitoring

Contribution:

(i) Ex-post heterogeneous borrowers in maturity mismatch model
(ii) Naturally, question arises of allocation vs. resilience tradeoff
(iii) Derive optimal repo market structure